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ABSTRACT

At present, little or no overt attention is paid to internationalizing the preservice curriculum for prospective science teachers, despite the fact that there is an international character to science teacher education. Scientific vocabulary, as well as the symbolism and the numerical system used for calculations, is international. Preservice teacher education also receives a certain international character through the practice of bringing historical perspectives into science teaching through a study of the scientific contributions of important individuals or events from and in a wide range of countries. At the inservice level, more internationalizing of teacher education is occurring through international science competitions, conferences, and scientific organizations. Suggestions are made for expanding and enriching the international approach to science education, particularly through more extensive teacher and student exchange programs, correspondence and publication, and an international exchange of computer software for science teaching. (JD)

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TITLE Internationalization the Education of a Science Teacher

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INTRODUCTION

As an international science educator, one who has worked extensively in countries such as India, Thailand, Qatar, China, Israel, Nigeria and nearly all countries of Eastern and Western Europe, I am very conscious of the parochialism of the science eduction system in the U.S. We often excuse this state of affairs by contradictorily saying either "science is international by definition," or, "science deals with a body of knowledge, facts, concepts, and laboratory experiences that do not lend themselves to internationalizing." Neither statement is quite true and neither excuses tunnel vision, a syndrome that exists among U.S. science educators. Our undergraduate pre-service curriculum and our in-service opportunities both need modification to sensitize teachers to a more global perspective.

MORE OF WHAT OUGHT TO BE

One of the discouraging problems in trying to think about internationalizing science education, is that there are so very few students in the pre-service programs in America, and so many unqualified teachers--certificated, but unqualified--in the classrooms. The number one priority is to raise the level of competence and confidence of teachers who are not adequately

prepared to teach science. Attention to internationalizing the education of a science teacher is far down the list of priorities.

In this paper, I will attempt to illustrate what is, what is beginning and ought to be expanded, more of what ought to be and how to further internationalize the education of a science teacher and I shall do so both from the perspective of the pre-service teachers and the in-service teachers since they are so closely intertwined.

WHAT IS

At present, little or no overt attention is paid to internationalizing the curriculum for pre-service science teachers. Neither in the approximately thirty semester hours of science study in a particular discipline, nor in the thirty semester hours or more of additional sciences and mathematics related courses, nor in the professional education courses, (e.g. methods, educational psychology, supervised teaching, etc.) is any attention normally paid to international perspectives. Computer science courses have generally replaced foreign language study for science majors and the liberal arts courses required to broaden the education of the undergraduate can be entirely devoid of international character.

Yet, in fact, there is an international character to science teacher education. Scientific vocabulary is international. So is the symbolism and the numerical system used for calculations. The concepts are universal and the laboratory experiments done in the undergraduate programs have been generated and shared internationally.

One can walk into a university in Western Europe, or in Eastern Europe, or in China, and see similar apparatus in use, and similar experiments being performed and discussed. In American chemistry classrooms a periodic table that could be read and used in any other classroom in the world is normally present. The terms molecule, atom, erg, nucleus, celsius, cell, DNA, Richter Scale, as examples, are used in countries throughout the world.

When Thailand produced new science curricula and the supportive teacher education for the schools in the 1970's, and attempted to coin new Thai words to represent modern concepts in science, they found that students adjusted much more quickly to the international vocubulary than to novel terminology in Thai. This experience was repeated in country after country during the 1960's and 1970's at the peak of science curriculum reform, until the English terminology, with Latin and Greek origins, became the accepted vocabulary across the world. Therefore, American pre-service teachers in their undergraduate studies, are learning and using the international language of science.

The same can be said for symbols and equations. This is particularly true in chemistry and physics. The symbols, mass numbers and atomic numbers for the 108 or so chemical elements are international, as are notations for the System International for measurement in chemistry, physics and the biological sciences. The Arabic and Roman system of numbers are used throughout the world. This makes it possible to pick up a science textbook in any nation and to be able to follow the flow of ideas and concepts without

knowing the language. The same formulas, equations, calculations, and notations are consistently used.

Many of these are developed and standardized by international organizations that take this responsibility. The International Union of Pure and Applied Chemistry (IUPAC) maintains cognizance over chemical nomenclature and symbolism. In physics, the International Union of Pure and Applied Physics (IUPAP), and in the biological sciences, the International Union for Biology (IUB) do the same. Similar international organizations exist for geology, mathematics, astronomy, conservation of nature, and other related disciplines. The results of deliberations of these international bodies are regularly published in U. S. journals of science education, and utilized by the science and science education professors in their undergraduate teaching.

Another way in which pre-service teacher education receives a certain international character is through the practice of bringing some historical perspective into science teaching through a study of important events and individuals. Textbooks deal briefly, at least, with such eminent international scientists as Albert Einstein, Enrico Fermi, Neils Bohr, or Lisa Meitner who played important roles in the development of atomic energy during World War II and in the modern theories of atomic and nuclear science, quantum mechanics and relativity. If we move to an even earlier period, the achievements of scientists from other countries are always a part of the undergraduate curriculum in science in this nation. These include individuals such as Marie Curie of Polish origin, her French husband

Pierre, and her daughter Irene Joliet Curie, and their great advances in chemistry and physics. Other examples are Louis Pasteur and Charles Darwin from the biological sciences, Dimitri Mendeleev, and Lothar Meyer, for their work in developing the concept of periodicity and the periodic table or Isaac Newton, Torricelli or Lord Kelvin in physics. A very long list of such individuals that have influenced the development of science is possible; every textbook at the undergraduate level features some of these international scientists.

Depending on the interest of the instructor, there may be some attention to science education in other countries (e.g. the curriculum, teaching methods, assessment, research findings, etc.)in pre-science courses, but this is not regularized. It depends on the individual knowledge and interest of instructors in professional education courses.

The primary internationalizing influence in pre-service education is in the science content courses, but neither the professor nor the students are very aware of this happening.

WHAT IS BEGINNING AND OUGHT TO BE EXPANDED

International Competition. At the in-service level, more internationalizing of science teacher education, is occurring. As an example, the American Chemical Society in 1983, decided to enter the International Chemistry Olympiad. This is a program that brings four students and two teachers from each of approximately twenty

countries together, in July, for a international competition in the laboratory and in theory and calculations. In 1984, the Chemistry Olympiad was held in Frankfurt, Germany. It will occur in Brataslavia, Czechoslovakia in 1985, and in the Netherlands in 1986. Local sections of the American Chemical Society across America work with teachers in local schools to select outstanding students to compete in national and international programs. This activity is rapidly heightening the international perspective of chemistry teachers as they prepare their students for such a competition. Two U. S. teachers will act as mentors and accompany the students abroad each year. They then report at meetings of the American Chemical Society and National Science Teachers Association and publish journal articles, thus sharing their international experience with hundreds of other teachers.

Another international competition that sensitizes teachers to science education beyond our borders, is the International Science and Engineering Fair held each year. Competitors from many nations participate, and U.S. teachers accompany winning students to this event.

Now, in the State of California, teachers are nominating their outstanding students for an expense-free trip to Stockholm, Sweden, in December, to participate in the Nobel Award ceremonies. In doing so, the perspective and awareness of these teachers is broadened.

International Conferences. Again, using chemistry as an example, every two years, an international conference on chemical education brings together teachers from approximately 80 nations to share ideas, learn from the experts, and develop an international community and an international esprit de corps for their continuing work. Recent international conferences on chemical eduction have been held in Yuguslovia (1977), Ireland (1979), United States (1981), France (1983), and the ninth international conference is scheduled to be held in Tokyo, Japan, in August of 1985. American high school teachers have been participants in each of these conferences. University colleagues have sought funding from the National Science Foundation to permit half of each delegation of approximately thirty to be classroom teachers. In addition to the overseas trip, more than 100 American teachers were able to participate in the international conference hosted by the University of Maryland in 1981 and to gain a truly international experience in concert with another 500 participants, from more than 80 from countries around the world. The inclusion of American teachers in the delegations and on the programs is having a major impact on internationalizing the chemistry teacher community. Similar conferences with strong teacher involvement occur in physics and mathematics.

International Centers. In addition to the international conferences on chemical education, an international center for chemical studies and an international center for physics studies have been established. The first is located in Ljubljana, Yugoslavia, and the second in Trieste, Italy. Both of these centers plan seminars,

workshops, and other activities for school teachers. American participation has been relatively low in these centers but the potential for increased international activity exists.

International Publications. The umbrella international scientific organization, the International Commission of Scientific Unions, ICSU, maintains a committee on the teaching of science. So does each of the individual international unions, such as the International Union for Pure and Applied Chemistry, Biology, Astronomy, Physics, etc. Each of these teaching commissions publishes newsletters which reach some American teachers and teacher educators. In addition, the European Journal of Science Education is available in many school or district libraries. The UNESCO volumes, Trends in Chemistry, Physics, Biology and Integrated Science Teaching, are disseminated widely and are generally available in the school libraries. The UNESCO Source book for Science Teaching and the recently published Teaching School Chemistry feature American authors and editors along with international colleagues.

Such databases as Chemical Abstracts, which are very international in the scope of their coverage, are increasingly available to teachers in the Information Age. Pre-service teachers have an opportunity to use these databases as undergraduates and experienced teachers are encouraged to make use of them through in-service programs that are being offered.

Travel Programs. American teachers have more opportunity to travel now to other nations and to internationalize their view of the world. For example, the National Science Teachers Association (NSTA) takes a delegation of teachers each year to the Association for Science Education (ASE) meetings in the United Kingdom. In turn, ASE brings some of their numbers here for the National Science Teachers Association meetings. Each national meeting of NSTA features a reception for international visitors, where American teachers may meet and mingle with teachers from Canada, Japan, Mexico, UK, France, Germany, Australia, and the many other nations that are beginning to participate regularly in the NSTA conferences.

In addition, the NSTA selected a group of six teachers in 1984 to spend six weeks in Thailand, working in the Institute for the Promotion of Science and Technology Teaching, IPST, in that nation. IPST has a remarkable record of curriculum development, research, and instructional methodology achievement. It was a benefit for American teachers selected by NSTA to have this cross-cultural experience, and to bring back many ideas for use in their own classrooms and it is anticipated that this activity, funded by the National Science Foundation, will continue each year for the forseeable future.

In addition, NSTA organizes summer programs abroad for teachers. Other programs of this nature are conducted from the University of Alabama in Birmingham, from the University of Southern Illinois at Carbondale, and Temple University. Teachers are able to register for

credit and travel to Western Europe, Russia or China, under these programs, to learn about other teachers and science teaching systems.

For example, teachers in Alabama have a week off in April for education association activities. In order to utilize this time for instructional purposes, a study-travel program called "Great Cities and their Scientists" has been organized. A typical format would include a series of Saturday seminars during the academic year to learn about a famous city and its scientists. One such program was developed around London, for example. After the seminar, and during the Alabama Educational Association week, the teachers traveled to London. While in London, they visited the science museums, toured the Royal Institution, attended lectures, including one by Sir George Porter, visited Oxford Univesity, etc. In the evening, discussions allowed the teachers to pull experiences together. After returning to Alabama, these teachers attended a final seminar and prepared a report on their experiences, and how they would incorporate what they had learned into their classrooms. Other study-travel programs have taken these groups to Paris and to Vienna and more are planned for the future.

Teachers from Abroad. But travel is a two-way road. Due to the shortage in science teachers, two states have been experimenting with bringing teachers from other countries into U.S. classrooms. Nebraska invited teachers from Australia to come and teach for two years in their system. Georgia invited teachers from Germany, and will continue this experiment during the 1985-86 school year, since

it has been deemed successful. As these teachers from other countries come into American schools to help alleviate the shortage of qualified science teachers, they interact with their American colleagues in the school and strong internationalizing effects occur.

International Visitors. A small program full of impact operates informally across the U.S. Traveling groups of teachers sponsored by their own governments visit the U.S. on two-week to three-month study tours designed to acquaint them with American style science education-classroom facilities, teaching methods, textbooks, computers and other instructional materials. As these international teachers visit American schools and exchange ideas with the American teachers an internationalizing influence occurs. Unfortunately, this program is small and largely constrained to geographic areas that lie in a narrow belt across the U.S. that most often includes New York, Washington, Chicago, and San Francisco or Los Angeles.

Another type of visitor, but one that intends to stay, is the immigrant. As large numbers of children of immigrant families coming to the U.S. from Southeast Asia, Eastern Europe, and Latin America, enter the classrooms, their impact upon their fellow students, and especially on the teachers who must instruct them, is internationalizing in scope. The tragedy is that teachers have not recognized the rich resource that these immigrant students represent. They rarely capitalize on the opportunity to bring new knowledge and new cultural perspective into their classrooms as well as to enrich their own education for future years of teaching.

International Exchange. Two-way international exchanges of teachers occur on a very small scale. The Fulbright program, administered by the Department of Education, has a modest teacher exchange component. In addition, individual teachers arrange an exchange where one, for example, goes to New Zealand to teach for a year and his New Zealand counterpart teaches in an American school. The NSF-funded institutes of the 1960's and 70's opened many such opportunities for exchange. Each institute allowed for several teachers from other nations to join with their American counterparts. American teachers taught in India in similar programs. International understanding, courtesy and interdependence are essential for world peace. People throughout the world seek peace and stability. The exchange of scholars at the school level as well as in high education can help to promote mutual understanding, and to provide a global perspective, particularly when those teachers in America who have the opportunity to travel abroad share their experiences with colleagues through workshops, seminars, and other means of transmitting their knowledge. Those who choose the teaching profession are people oriented. Their interest can be quite readily extended to people of other cultures with a little extra effort on the part of college and university professors who help mold the beginning teacher.

However, loss of funding to the National Science Foundation for such programs has strongly inhibited this international exchange.

Materials and Ideas Exchanges. An international exchange of software for science teaching has begun. The Canadians, British, Australians and the Americans exchange curriculum ideas, evaluation systems, and computer software. French science educators are developing excellent simulation software, and since these are not dependent on language, with the concepts conveyed largely through graphics, the exchange of software with the French has begun and is successful.

The Journal of Chemical Education devotes approximately 25 percent of its pages to reporting international ideas, results, and collaborations. Since the Journal of Chemical Education now also devotes a major section of its pages to pre-college teachers, this serves as an excellent medium of exhange between and among pre-service and in-service chemistry teachers. Similar, but less intensive, attention to international authors and ideas appears in publications such as Physics Today, the American Biology Teacher, the Journal of Geological Education and The Science Teacher.

However, there are so many organizations to join, that teachers are not able to pay the dues for all of them. A small percent of science teachers actually hold membership in these national and international organizations and thus receive their journals and newsletter directly. The large majority depend on library subscriptions in the teacher training institutions and in the schools, and use them primarily when they have some particular assignment to complete.

Internationalizing Topics. There are science topics that lend themselves particularly well to sensitizing science teachers to global perspectives and international dimensions. To date, these have not been used very much. Let me cite some examples.

1. One example is the acid rain problem. Pollutants from industrialized regions of the world enter the atmosphere and are carried by the global winds across state and national boundaries. They then dissolve and are precipitated out in rainfalls with a pH lowered from the normal range of 6-7 to a very acidic 3 or even lower. The result is defoliation of flora, killing of fish and other life in ponds and lakes, heavy chemical weathering of buildings, statuary, roadways, etc. This problem is truly an international problem in science education, wherein the concepts of science and the international dimension can easily be interwoven in classrooms.

2. Another example is the theory of a nuclear winter and all of the concepts embodied in it. Teachers can be taught to think in global terms through study of natural events that affect the whole earth. Basic ideas from biology, physics, chemistry, the earth and atmospheric sciences are all embedded in gaining understanding of eruptions of such volcanos as Krakatoa in Indonesia in the 1800's, and the global effects. Dramatic darkness and change in climate and weather have been documented following that event. Teachers can then move to consideration of the physical and biological effects of a nuclear holocaust. Most scientists believe that such an event would be followed by a lengthy period of darkness due to the

heavy particle material in the atmosphere circling the globe, leading to consequent severe damage or death to flora, fauna, and humankind.

The theory of an asteroid striking the earth with enough impact to vaporize and spew particulate matter into the atmosphere to change the climate and cause the extinction of the dinosaurs, is another idea with international dimensions that demonstrates the unity of the global air mass and the consequent interdependence of nations. The conservation of oceans, the hydrosphere, the atmosphere, outer space, and the land itself are all heavily laden international topics.

Plate tectonics and earthquake prediction are subjects of intense interest in China, in Japan, in the Middle East, and in the western region of the United States. The scientific advances made in each of these regions can readily be brought into the science classrooms and used to prepare teachers--pre-service or in-service--to think more globally. A study of the world's ecosystems should be incorporated into pre-service education.

High-tech Education. High-tech tranfer is occurring around the world. American computers are moving into USSR, Eastern Europe, and many other nations and regions of the world. The same is true of those from Japan and England. They are moving into this country as well as to other areas of the world. Science teachers must become

aware today that high technology, microelectronics, robotics, chemical engineering and other industrial processes, with all of their science and technology bases, are truly international and multi-national ventures. Young people in school need to be helped to an understanding of the Information Age revolution that is occurring in their lifetime. Computer science/technology education for pre- and in-service teachers is essential to foster this understanding.

Scientific Conference Results Translated for Classroom Use. New movements, such as CHEMRAWN (Chemical Research Applied to World Needs) and an even newer possibility, SCIRAWN (Scientific Research Applied to World Needs) are gaining momentum. The CHEMRAWN conferences, held every two years in different parts of the world, address such topics as feeding the world, conserving the oceans, and utilizing synthetic materials to improve the quality of life. The results should be prepared for school use and materialize in pre- and in-service education programs to heighten the understanding of international science and technology issues and third world needs.

Social Decision Making Based on Science Literacy. Mankind is on a spaceship, a very fragile spaceship, in the universe. It is important for us to understand how easily we can destroy this environment through unwise political, economic, cultural, scientific or social activities. Social decision-making, based on scientific literacy and related to preserving our environment and our planet, is a new trend in science curriculum development. This trend can be seen in the NSF-funded Chemistry for the Community (CHEMCOM) Project

of the American Chemical Society and in the Chemical Education for Public Understanding (CEPUP) Project, concerned with toxic chemicals, being developed at the Lawrence Hall of Science at University of Calfornia Berkeley, as examples.

Foreign Language Study. At present, pre-service teachers are not required to take a foreign language as part of their undergraduate education. Perhaps they should be. Perhaps every educated individual in this nation should have some fluency in another language, as is typical of our teaching counterparts in almost all other nations of the world. They know their own language and they know English, which is rapidly becoming the international language of communication, especially in the science and technology fields. This is becoming even more evident as software development and science abstracts and databases spread around the world in the English medium.

The semester abroad concept is largely utilized by prospective teachers of foreign languages. Why shouldn't it be utilized by prospective science teachers as well? The history of science lies primarily in Europe, the Middle East, and Asia, far removed from U.S. shores. A semester abroad in an area rich in science history would strengthen the internationalizing of science teachers.

A Comparative Education Component. A course or unit in comparative science education would be very interesting and worthwhile in teacher education. Perhaps a short module could be inserted into the pre-service methods courses and a full-blown course become part

of in-service education. Such a teaching unit or course should include information on science curriculum development and teacher training around the world, with particular attention to those projects that have been most successful and can set models for us in U.S. education. These would include courses developed in the United Kingdom and other Western European countries, and in Australia, Canada, and Southeast Asia. Teacher education programs from Russia and Eastern Europe would be useful, too.

A remarkable project, mentioned earlier, is the work of the Institute for the Promotion of Science and Technology Teaching, IPST, in Thailand, which concurrently incorporates curriculum development, equipment and instructional materials development, teacher training, assessment, research, the use of audio-visual aids, and networking with teacher training colleges and high education. Such a model could be of value in demonstrating new and effective science education techniques to prospective teachers. It is all the more effective since these achievements are emanating from a developing country, and are based on earlier U.S. models.

Once there existed a fine resource for a comparative education unit, the International Clearinghouse Report, edited by J. David Lockard at the University of Maryland, and published every year or two during the late 60's and early 70's. These volumes were used in the preparation of American pre-service and in-service teachers and served as an excellent reference to internationalize, even modestly, the science education curriculum. Now the Clearinghouse Report is too out-of-date for anything except historical use. The UNESCO Trends Volumes, the UNESCO Science Teaching Sourcebook, and other

teaching publications such as the Teaching of School Chemistry pick up these responsibilities to some degree. But these publications are not well disseminated in the U.S., and they are not generally included as a part of pre-service course.

WHAT IS NEEDED--HOW TO DO IT

1. Funding through Federal agencies such as NSF, NIE, FIPSE and through the states under the Economic Security Act of innovative pre-service programs that include an international component. The innovators exist; stable funding is needed.

2. Action from professional science societies such as the American Association for the Advancement of Science (AAAS), the American Chemical Society (ACS), the American Association of Physics Teachers (AAPT), The National Association of Biology Teachers (NABT), etc. taking responsibility for preparing materials and organizing meetings aimed at internationalizing pre-service amd in-service education. Instructional materials can be prepared that use cross-cultural scenes, international ecosystems, or natural resources such as the oceans and the hydrosphere, as examplar modules to be used in pre-service methods courses and during student teaching.

3. Action from professional education societies. International education, as pointed out by Alger and Harf, is a diverse and highly decentralized movement that needs to be altered. American organizations that deal with the preparation of teachers, such as the National Science Teachers' Association (NSTA), the American Association of Colleges for Teacher Education (AACTE), and others,

can make concerted effort to focus attention in the curriculum on at least a limited number of international interactions.

Questions of populations, food and nutrition, health and medical care, agriculture, irrigation and fertilization, microelectronics are just a few examples of important areas of science that transcend all national boundaries. Sources of energy, protection of the environment, all of these represent the multi-national world in which we live, and the teeming array of transactions and interactions that are essential for continued human existence.

When we all have such an important stake in world understanding, conservancy and peace, it is puzzling and bordering on the irresponsible that our teacher organizations leave these important issues so much in the hands of a few politicians. It is our whole public that needs to be prepared to respond to science and technology-based international questions and the place to prepare them, is, of course, in the classrooms of America, when mass education is in effect and all our young people can be reached. That requires well-qualified teachers with an international orientation and teacher organizations must focus on and facilitate the preparation of such teachers.

4. The pre-service preparation of teachers, must become a high priority goal in America. The politicians and the public must be so educated through the media, town meetings, and every mechanism that exists. Just as the role of scientists, technicians, engineers, is essential to advancement of our civilization, so, and even more so, is the quality of science education in preparing young people and

the public at large to exercise decision-making in their personal lives and in their communities and nations in responsible ways that grow out of understanding. Young teachers who are confident in their subject matter, but who have this broader perspective of science's impact on mankind, can help accomplish this goal.

5. International opportunities for in-science teachers must be increased. During the 1960's, a substantial number of American high school teachers were invited to help instruct and advise in summer institutes carried out in India under a U.S. Government--Government of India joint program. The impact on these teachers and their broadened perspectives of the world, was directly conveyed to their students. Further efforts of this type should be encouraged in the 1980's and 1990's.

6. Results from programs such as Man and the Biosphere, the Year of the Ocean, the International Geophysical Year, the U.N. Conference on Science and Technology and CHEMRAWN need to be translated for use by teachers in their teacher training programs and in their classroom instruction.

7. Understanding of other cultures, particularly those of the Asian and African regions of the world that view human beings as part of nature, and not independent from it, and that expect human beings to blend with nature and to adjust to the cycles and changes, is a point of view that needs to be conveyed also in our preparation of teachers.

Cross-Cultural Enrichment of Methods Courses. An inter-cultural richness is possible in methods courses and in in-service institutes as a result of the mix of people from many nations participating, partly through our immigrant population, partly through invited

teachers from other countries, partly through instructors with international experience. These are all assets for broadening and attaining a global perspective.

8. International conferences and exchange programs that promote learning and idea sharing must be increased. The possibility of exchanging information and travel has greatly increased since the beginning of this century. Satellite communication, rapid transit trains and supersonic aircraft, make it possible for human beings to conveniently travel from one side of the world to the other within a 24-hour period, or to complete a telephone call almost instantaneously, with lines as clear from Bangkok to Washington as from New York City to Washington.

9. Education for an age of high technology must be part of the pre-service curriculum. In the future, as electronic mail takes precedence over the current system of personal delivery, instantaneous communication with colleagues in any part of the world will become frequent and inexpensive. Computers are in nearly every school now. Training to use these new mediums of communication must be incorporated into teacher training programs.

10. The pre-service teacher population could be encouraged to take advantage of the opportunity to learn from the international corp of teaching assistants in their science laboratories and from their fellow students of different cultures.

11. A dramatic reform of pre-service education is needed. It's parochialism must be tempered and it's practical aspects must be emphasized with focus on content and methodology (some of the theory

in the current pre-service curriculum can wait for in-service education). Schools of education and science departments must learn to work in a true partnership to accomplish such reform.

12. A new global agenda needs to be set for all areas of teacher education, and then each component, (e.g., science) can pick up those threads that are most appropriate and carry its share of responsibility in internationalizing the pre-service curriculum.

There is an air of urgency about these changes. The world is not becoming a better place to live. In fact, regression is very apparent in some regions, most obviously in sub-Saharan Africa, and the recognition that our resources are finite with our population increasing, is an urgent message that must be conveyed through science education to the people at large.

In order to accomplish these goals, faculty must be retrained and sensitized to the needs for internationalizing the curriculum. The large majority of those teaching science courses in the disciplines, in the methodology courses and supervising student teachers in the professional sequences have had little or no international experience and exhibit little interest in global affairs. Many of the instructors in the science disciplines and in the supervision of student teachers are teaching assistants (TA's) whose primary goals are obtaining advanced degrees and not preparing their students for teaching careers.

This means that the teaching profession must become more professional. Clear leadership and priorities for the committed senior professor must be differentiated from those of the junior assistants. Many informal and uncoordinated programs and activities exist already in science education. Internationalizing science teacher education will develope further and faster when the problems of underqualified science teachers and uncommitted leadership are resolved.